REMARKS

This paper is being provided in response to the Final Office Action mailed August 23, 2004, for the above-referenced application. In this response, Applicants have amended claims 1 and 8 to clarify that which Applicants consider to be the invention. Further, Applicants have amended the specification for purposes of clarification. Applicants respectfully submit that the amendments to the claims are fully supported by the originally-filed specification and that the amendments to the specification do not add new subject matter.

Applicants thank the Examiner for allowing claims 16-18. Applicants note, for purposes of clarity of the record, that although the Office Action Summary indicates claims 16-18 are rejected, claims 16-18 are indicated as allowed on page 6 of the Office Action under the heading "Allowable Subject Matter".

Applicants have amended the specification, as noted above, with further description of the pattern of S and N poles as shown in Fig. 3B. Applicants submit that no new matter is added by this amendment.

The rejection of claims 1, 2, 4, 8-11 and 13 under 35 U.S.C. 103(a) as being unpatentable over JP 11-146616 to Suzuki et al. (hereinafter "Suzuki") in view of JP 05168181 A to Otsuki et al. (hereinafter "Otsuki") is hereby traversed and reconsideration is respectfully requested in view of the amendments to the claims contained herein.

Independent claim 1, as amended herein, recites a DC motor. A rotor unit is rotatably arranged within the motor and includes a cylindrical field magnet having a single structure with a rotating shaft press fit at the center. The cylindrical field magnet is magnetized such that S and N poles alternate in a circumferential direction. A stator unit is arranged circumferentially around the rotor made of a plurality of stator yokes. The yokes are made of a large number of circumferentially-stacked thin plates, each of which is a salient pole, and to which is attached a plurality of coil units made by winding a magnetic wire on a bobbin. Each of the S and N poles has a plurality of stage in the axial direction, and are circumferentially shifted from each other by a predetermined shift amount, boundaries between the S poles and the N poles being formed in a stepped shape in parallel with an axis of the rotating shaft. Claims 2-7 depend on independent claim 1.

Independent claim 8, as amended herein, recites a DC motor. A rotor unit is rotatably arranged within the motor and includes a cylindrical field magnet having a single structure and fixed to holder means in which a rotating shaft is press-fitted at a center thereof. The cylindrical field magnet is magnetized such that S and N poles alternate in a circumferential direction thereof. A stator unit is circumferentially arranged around the rotor unit and includes a plurality of stator yokes so arranged as to oppose the cylindrical field magnet. Each of the stator yokes includes a large number of circumferentially-stacked thin plates each of which constitutes a salient pole, and a plurality of coil units. Each of the S and N poles has a plurality of stages in an axial direction and shifted from each other in the circumferential direction of the cylindrical field magnet with a predetermined shift amount, boundaries between the S poles and the N poles

being formed in a stepped shape in parallel with an axis of the rotating shaft. Claims 8-15 depend on independent claim 8.

The Suzuki reference discloses a cylindrical motor structure including a rotor unit with a cylindrical rotor magnet 13. The rotor unit includes a salient pole 23 and a winding part formed by adjusting its dimension in an axial direction and layered in the circumferential direction. An armature is arranged by inserting a coil 12 whose magnet wire is wound around the winding part of the salient pole and press-fitted to a stator 20. (See Abstract, Figures 1, 2 of Suzuki.)

The Otsuki reference discloses a revolving magnetic field type motor comprising a rotor (20), which is rotatably arranged within the motor and includes a cylindrical field magnet (7) having a single structure, but divided into two magnetized portions (20a, 20b) in an axial direction thereof with multiple stages of S and N poles. The poles are shifted from one another around the axis of the rotor by a skew angle (θ2) corresponding to half of the wavelength of first cyclic torque ripples. (See Figs. 10 and 11 of Otsuki).

Applicants independent claims recite at least the features of a rotor unit of a DC motor that includes a cylindrical field magnet having a single structure and that is magnetized such that S and N poles alternate in a circumferential direction thereof, and wherein each of the S and N poles has a plurality of stages in an axial direction and shifted from each other in the circumferential direction of the cylindrical field magnet with a predetermined shift amount, *boundaries between the S poles and the N poles being formed in a stepped shape in parallel with an axis of the rotating shaft.* Applicants have found that a DC motor having a single structure

cylindrical field magnet with magnetized poles having boundaries configured as recited provides for a simplified structure in which cogging is reduced and vibration is decreased while the performance such as torque is maintained. (See, for example, page 4, lines 15-24 and Figure 3B of the present application.)

Applicants submit that neither Suzuki nor Otsuki, taken alone or in combination, teach or fairly suggest at least the above-noted features as claimed by Applicants. Suzuki does not disclose poles of a cylindrical field magnet that are configured as claimed by Applicant. As noted above, Otsuki discloses poles that are shifted from one another around the axis of the rotor by a skew angle (θ2) that is angled with respect to the axis of the rotor. (See Fig. 11 of Otsuki.) In general magnetization on the field magnet is carried out by a magnetizing yoke. That is, the magnetizing yoke has at the inner peripheral surface thereof a plurality of grooves into which coils are wound. In order to perform the magnetization with the skew angle (θ2) as disclosed by Otsuki, it is arguably necessary to form a plurality of inclined grooves at the inner peripheral surface of the magnetizing yoke which is a difficult machining process particularly in a small-sized magnetizing yoke for magnetizing a small-sized field magnet.

In contrast, Applicants' present claimed invention recites that in a field magnet of a DC motor, boundaries between S pole and N poles are formed in *a stepped shape parallel with an axis of a rotating shaft*, as shown for example in Fig. 3B of the present application, without having a skew angle as disclosed by Otsuki. Grooves arranged in parallel to the axis of a rotating shaft, as shown in Fig. 3B, can be formed by a relatively easy machining process as compared with that of Otsuki.

Accordingly, Applicants submit that neither Suzuki nor Otsuki, taken alone or in combination, teach or fairly suggest at least the above-noted features as claimed by Applicants. In view of the above, Applicants respectfully request that this rejection be reconsidered and withdrawn.

The rejection of claims 3 and 12 under 35 U.S.C. 103(a) as being unpatentable over Suzuki in view of Otsuki and further in view of U.S. Patent No. 5,034,642 to Hoemann et al. (hereinafter "Hoemann") is hereby traversed and reconsideration is respectfully requested in view of the amendments to the claims contained herein.

The features of independent claims 1 and 8 are discussed above with respect to the Suzuki and Otsuki references. Claims 3 and 12 depend therefrom.

The Hoemann reference discloses a permanent magnet rotor and motor. The Office Action cites Hoemann as disclosing that a rotor position detection element is adjusted by one-half the shift amount of respective stages.

Applicants respectfully submit that Hoemann fails to overcome the above-noted deficiencies of the Suzuki and Otsuki references with respect to Applicant's present claimed invention. Hoemann does not disclose a cylindrical field magnet of a DC motor in which boundaries between S poles and N poles are formed in a stepped shape in parallel with an axis of the rotating shaft. Applicants respectfully submit that neither Suzuki, Otsuki nor Hoemann,

taken alone or in any combination, teach or fairly suggest at least the above-noted features as is claimed by Applicants. Accordingly, Applicants respectfully request that this rejection be reconsidered and withdrawn.

The rejection of claims 5, 7, 14 and 15 under 35 U.S.C. 103(a) as being unpatentable over Suzuki in view of Otsuki and further in view of U.S. Patent No. 5,717,268 to Carrier et al. (hereinafter "Carrier") is hereby traversed and reconsideration is respectfully requested in view of the amendments to the claims contained herein.

The features of claims 1 and 8 are discussed above with respect to Suzuki and Otsuki. Claims 5, 7, 14 and 15 depend thereon.

The Carrier reference discloses an electric motor with a tachometer signal generator. The Office Action cites Carrier as disclosing a DC brushless motor with an eight poles outer rotor and a six poles stator unit.

Applicants respectfully submit that Carrier fails to overcome the above-noted deficiencies of the Suzuki and Otsuki references with respect to Applicant's present claimed invention. Carrier does not disclose a cylindrical field magnet of a DC motor in which boundaries between S poles and N poles are formed in a stepped shape in parallel with an axis of the rotating shaft. Applicants respectfully submit that neither Suzuki, Otsuki nor Carrier, taken alone or in any combination, teach or fairly suggest at least the above-noted features as claimed by Applicants. Accordingly, Applicants respectfully request that this rejection be reconsidered and withdrawn.

The rejection of claim 6 under 35 U.S.C. 103(a) as being unpatentable over Suzuki in view of Otsuki and further in view of U.S. Patent No. 4,998,032 to Burgbacher et al. (hereinafter "Burgbacher") is hereby traversed and reconsideration is respectfully requested in view of the amendments to the claims contained herein.

The features of claim 1 are discussed above with respect to Suzuki and Otsuki. Claim 6 depends therefrom.

The Burgbacher reference discloses a permanent magnet excited electric motor. The Office Action cites Burgbacher as disclosing a DC brushless motor with an eight poles inner rotor and a six poles stator unit.

Applicants respectfully submit that Burgbacher fails to overcome the above-noted deficiencies of the Suzuki and Otsuki references with respect to Applicant's present claimed invention. Burgbacher does not disclose a cylindrical field magnet of a DC motor in which boundaries between S poles and N poles are formed in a stepped shape in parallel with an axis of the rotating shaft. Applicants respectfully submit that neither Suzuki, Otsuki nor Burgbacher, taken alone or in any combination, teach or fairly suggest at least the above-noted features as claimed by Applicants. Accordingly, Applicants respectfully request that this rejection be reconsidered and withdrawn.

Based on the above, Applicants respectfully request that the Examiner reconsider and withdraw all outstanding rejections and objections. Favorable consideration and allowance are earnestly solicited. Should there be any questions after reviewing this paper, the Examiner is invited to contact the undersigned at 617-248-4038.

Respectfully submitted,
CHOATE, HALL & STEWART

Date: November 19, 2004

Donald W. Muirhead
Registration No. 33,978

Customer No.: 26339
Choate, Hall & Stewart
Exchange Place
53 State Street
Boston, MA 02109
Phone: (617) 248-5000
Fax: (617) 248-4000